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NAVAL POSTGRADUATE SCHOOL
Monterey, California

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A MANAGEMENT INFORMATION SYSTEM
FOR THE PURCHASING ACTIVITY AT
THE NAVAL POSTGRADUATE SCHOOL

by

Victor E. Cunningham
December, 1982

Thesis Advisor: Norman Lyons

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A Management Information System for the Purchasing Activity at the Naval Postgraduate School

by

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Lieutenant Commander, Supply Corps, United States Navy
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I. INTRODUCTION

A. GENERAL

The process of change or transformation is difficult to initiate within any established organization. In 1513 Machiavelli observed:

> "There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old system and merely lukewarm defenders in those who would gain by the new one."

These words are as accurate today as in 1513 and are most appropriate to any discussion regarding the development of a management information system (MIS). Such a system must consider what is apparently an endless succession of physical and social patterns of interaction ranging from document preparation and flow to the socio-political aspects of each job position within the organization. An approach of this nature may seem overly broad to most, but in actuality, is the only reasonable approach to take if one wishes to truely integrate an MIS into the daily routine. Systems which have failed to consider this broad spectrum have typically ended in disuse because:

1. The end product was unsuitable due to inadequate research and development.
2. The end product was efficient but not effective as viewed by the users.
3. The 'shock' of change and the manner in which the conversion was accomplished resulted in rebellion by users---perhaps to the point of sabotage to the system.

B. PURPOSE

This paper will document the development of a Management Information System (MIS) for use by the purchasing activity at the Naval Postgraduate School by addressing the policies, practices, procedures and processing techniques currently in use, and by offering recommended changes to the existing system which will enhance both the efficiency and effectiveness of the organization.

C. APPROACH

The quantum improvements in office automation and information systems in general during the last decade have been unprecedented. These improvements have prompted ongoing reviews of intra-office efficiency and effectiveness and stimulated the collective imagination of every office manager. In the private sector, the quest for improvements in management information has been spurred on by the ever present profit motive and desire to accomplish more with less input. Within the Department of Defense, the dual forces of increasing budgetary constraint and decreasing personnel availability have precipitated similar reviews. Automation of the purchasing activity at the Naval Postgraduate School is being pursued as a means of enhancing management's control and understanding of the work environment--thus improving the effectiveness and efficiency of individual workers.

The author has approached this project having been advised that automation of the purchasing activity is a primary goal and that some form of "computerization" will ultimately be applied. At this time, however, there is no indication as to the type of system desired or the type which is best suited to the needs of the activity. Many options are available--ranging from a time sharing

arrangement on an existant Navy-owned mainframe facility to a more dedicated system composed of a small mini or micro computer and associated peripherals. It is felt that the nature of the existing activity, and that of similar small purchasing activities Navy-wide, is most conducive to the application of computerized technology.

D. RESEARCH QUESTION

The research question for this study is: "How can quantum improvements in computer technology best be applied to the Naval Postgraduate School purchasing activity to enhance management control and decision making?" The following ancillary issues will be addressed:

1. What management information is currently being utilized?
2. What new forms of information could be economically developed to assist in managing the purchasing activity?
3. Could new information forms be developed for dissemination at the lowest levels of the organization to improve buyer awareness of individual performance?
4. Given a requirement to construct a computerized data base, what data elements are appropriate to capture and how could they be used?
5. What hardware types and what capacities are required to support an MIS for a small purchasing activity?

E. SCOPE AND LIMITATIONS

This analysis is being conducted with some degree of predisposition in that the decision to apply some form of automation to the activities of the purchasing branch is a fait accompli, and that senior management personnel within the Supply Department have elected to begin this process by

initially implementing an MIS. No attempt is being made to develop a completely automated transaction processing system. However, collection of data on every transaction is absolutely necessary to the development of accurate management information, and it is reasonable to assume that follow-on development should be able to use the existing data base configuration to further develop a fully automated transaction processing system. The approach throughout this study is one of complete autonomy of system design. Impact upon the operations of other branches and/or divisions within the Supply Department is not desired.

F. ASSUMPTIONS

The following assumptions have been made regarding the design of this system:

1. Cost and reliability of the system are primary constraints to be considered in the development process. Ideally, this system should be highly reliable yet cost less than $10,000.00 to facilitate its procurement.
2. The system should be a separate information system and should not directly affect production within the work unit--except in the sense that it improvements efficiency through better management control.

G. ORGANIZATION OF STUDY

This study has been logically organized to present the reader with an initial analysis of the system as it exists in its purely manual form. It then transitions to a proposed system which will improve management control of the work unit by supporting data element capture and report generation through automated means. The final chapter makes specific recommendations regarding hardware acquisition for

support of the proposed MIS at the Naval Postgraduate School and offers insight into possible system configurations at other small purchasing activities.

II. ANALYSIS OF CURRENT PROCEDURE

A. ORGANIZATION

The Purchasing Branch is responsible for effecting the procurement of non-standard material or services for the Naval Postgraduate School and approximately 9 other commands within the geographical area. Typically, this entails processing 1,000 procurement transactions each month, ranging from no cost to hundreds of thousands of dollars. This workload is handled by 5 buyers, each of which has varying degrees of knowledge regarding the procurement process, and some of which specialize in specific types of transactions. This organization is functionally effective but lacks the management controls necessary to truely optimize performance.

Before proposing changes to the existing system, and the development of a new information system that will better support the needs of management, it seems appropriate to describe the present organizational structure. Figure 2.1 depicts the overall organization of the Supply Department.

Note that the purchasing function, which is the focus of this study, is assigned to the branch level of hierarchy under the cognizance of the Control Division. The purpose of the Control Division is to provide for the contracting of supplies and services, the requisitioning of materials, and the processing of invoices for payment. To accomplish these responsibilities the Control Division has been subdivided into the Issue/Receipt Control and Purchasing Branches. Figure 2.2 depicts the functional responsibilities of these two branches.

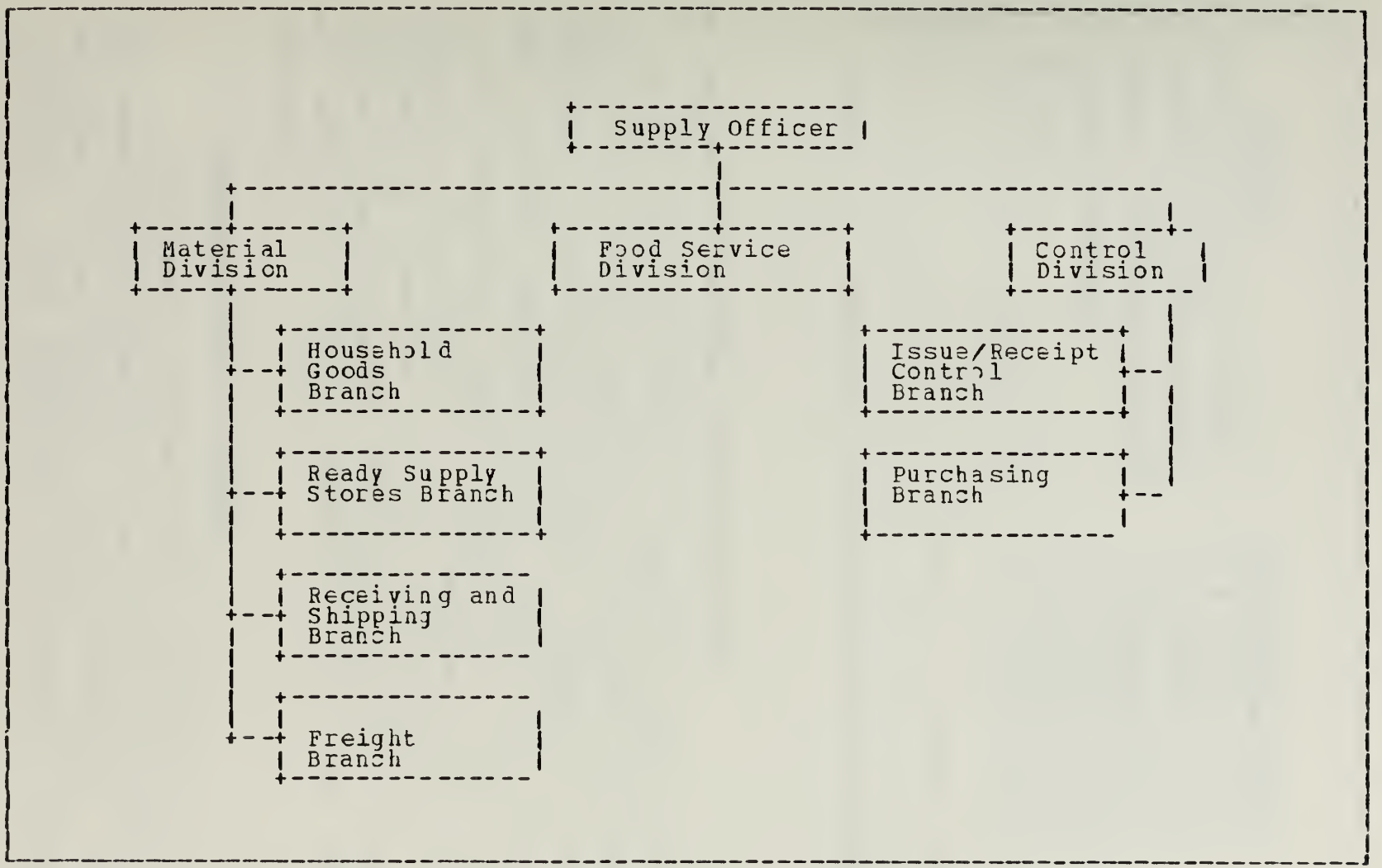

Figure 2.1 Supply Department Organization Chart.

FUNCTION	RESPONSIBLE BRANCH
Technical edit and review	I/R Control Branch
Standard Stock Acquisition	I/R Control Branch
Non-Std. Stock Acquisition	Purchasing Branch
Status Maintenance	I/R Control Branch
Follow-up	I/R Control Branch
Receipt/Invoice processing	I/R Control Branch

Figure 2.2 Functional Responsibilities by Branch.

B. REVIEW OF FUNCTIONAL RESPONSIBILITIES

Of the functions listed in Figure 2.2 only the acquisition of non-standard materials is considered to be under the cognizance of the Purchasing Branch. However, the technical edit and review function directly impacts upon the workload of the Purchasing Branch and for this reason will be included in the discussion. For purposes of this study the treatment of these two functional responsibilities will be limited to the discussion of primary functions, decisions, and information flows associated with the recurring processes.

1. Technical Edit and Review

The primary purpose of this function is to insure that requisitions submitted to the Supply Department are in the proper format and that required information is valid. In addition, each requisition is reviewed to determine if

the material falls into a material category that requires special processing.

There are two general types of requisitions--those which are for standard stock material and those which are not. Each type follows a particular processing path through the control division, and must therefore be discussed separately. Prior to being received by the control division all requisitions are reviewed by the Comptroller Department for financial obligation purposes (Job order numbers are matched against serial numbers to insure only authorized obligations are permitted further processing).

All requisitions are submitted on a DD Form 1348, or in a small minority of cases on a DD Form 1149. Figure 2.3 is an example of a completed DD Form 1348. When received by the Control Division, these documents are time stamped and sorted by standard and non-standard stock. It is the latter group which is of interest to the Purchasing Branch since they will ultimately become new inputs to the workload. Non-standard requisitions are reviewed to determine whether they fall into one of the following categories which require special processing and/or approval authority:

a. Photographic Equipment of Supplies
b. Reproduction Equipment or Supplies
c. Filing Equipment
d. Typewriters
e. Defense Industrial Plant Equipment
f. Plant Account Material
g. Labor Saving Devices
h. Mandatory Turn-in Repairables (MTR)

Requisitions are also reviewed to determine if the material requested is carried by the Ready Supply Store (RSS). This is accomplished by searching the RSS inventory catalog. If the material is carried, the DD Form 1348 is returned to the customer department for subsequent submission to the RSS.

For items with part numbers provided, a review of the Master Cross Reference List (MRCL) is performed. If a match is made, the stock number is verified against the Navy Management Data List (NMDL) to determine its validity. If it is a good stock number the request is returned to the customer department for preparation of a standard stock requisition. If a cross reference is not made or if a stock number proves erroneous based upon the NMDL review, a final attempt to cross reference the requested item to a national stock number may be made utilizing the following publications:

a. Afloat Shopping Guide

b. Federal Supply Schedules

c. General Services Administration (GSA) Catalogs

It is important to note that the degree of effort expended upon cross referencing a given procurement request is directly dependent upon the workload and the level of experience of the personnel assigned to the task. Not all items are reviewed; only those which the reviewer feels are prime candidates for cross referencing based upon intuition and experience will be rigorously reviewed. Upon completion of all checks and reviews, non-standard stock requisitions are forwarded to the Purchasing Branch.

2. Purchasing Branch Review

The Purchasing Branch of the Supply Department is responsible for the acquisition of all 'non-standard' material required to support the operation of the Naval Postgraduate School. The term 'non-standard' refers to material which is not routinely stockpiled in government warehouses and has therefore not been assigned a national stock number for purposes of ordering from selected stock points.

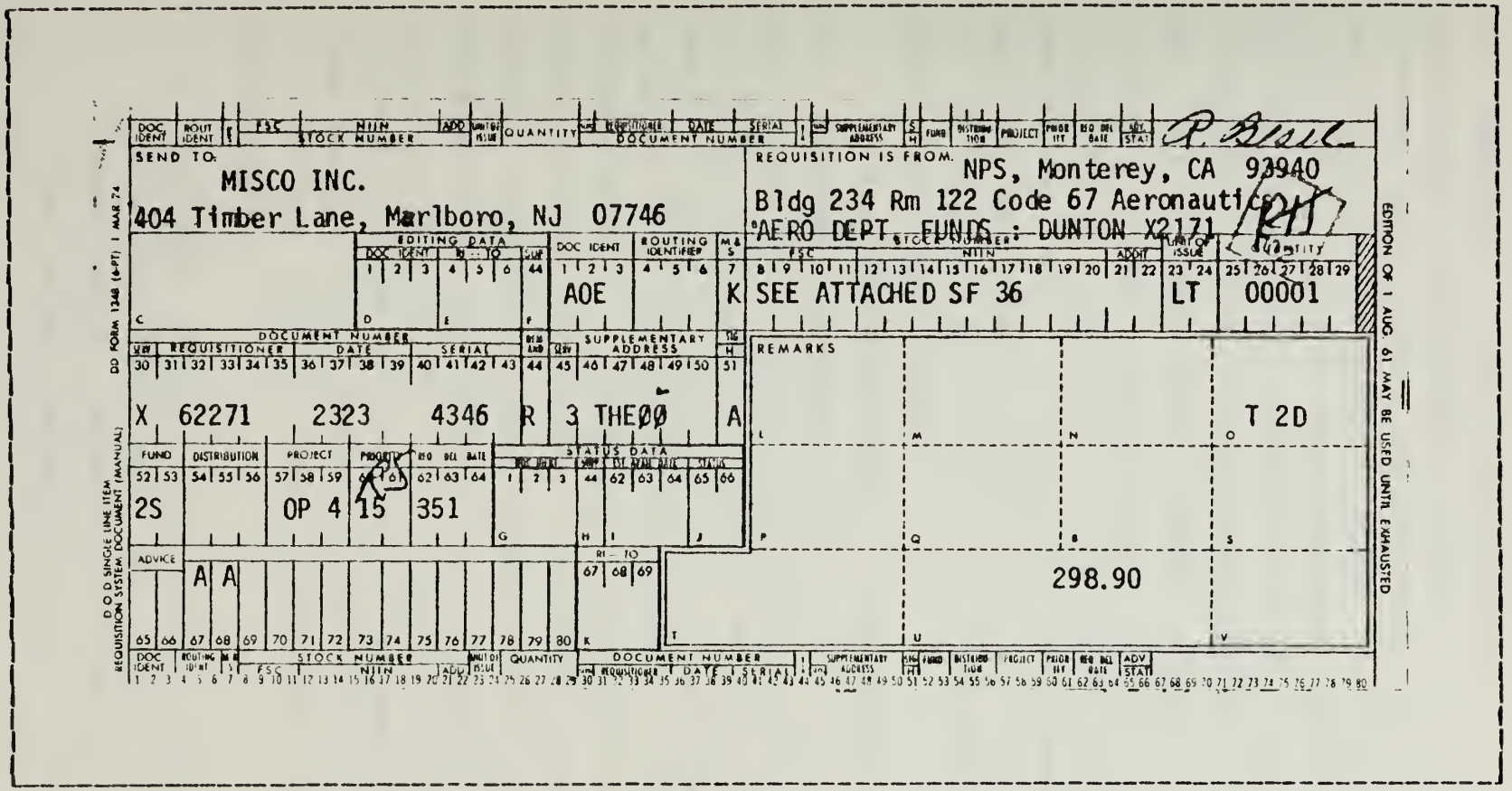

Figure 2.3 Completed DD Form 1348.

The tasking of this organization is like that of any procurement organization within the Defense Department however, it is unique in the sense that the ratio of 'non-standard' to 'standard' stock acquisitions is heavily inflated in favor of 'non-standard' material. In most operations the typical mix might be 20% 'non-standard' and 80% 'standard'. This is completely atypical of the operation at the Naval Postgraduate School where the above mix is inverted to 80% 'non-standard' and 20% 'standard'. This disparity is attributed to the unique nature of activities associated with a university environment wherein the majority of material acquisitions are for items which are not of a military nature and are therefore not maintained within the supply system.

Material acquisition is initiated by the submission of a properly prepared DD 1348 or DD 1149. These documents must have been properly screened by the Comptroller for purposes of obligating funds for payment, and they must have been reviewed by personnel in Issue/Receipt Control for possible 'filling' by way of 'standard' stock. If either of these actions is incomplete, they are returned for appropriate action and further procurement action is suspended. Visible evidence of appropriate action is certified by the appearance of the Comptroller's stamp in the upper right corner of the document and a date stamp on the back, accomplished by Issue Control when the document enters the Supply Department. These documents must contain several pieces of information without which procurement action cannot be initiated:

a. DOCUMENT NUMBER---This number consists of a unique unit identifier code, the julian date upon which the requisitioner prepared the document, and the requisitioner's next sequential serial number. This number

must be unique in the since that the requisitioner can identify a given acquisition from all other acquisitions given only this number. EXAMPLE: N12345-2180-1001

b. NOMENCLATURE---This is a description of the material or service which the requisitioner desires. It may be formated in whatever manner the requisitioner wishes but it must be understandable to personnel within the Purchasing Branch and must contain sufficiently explicit information to facilitate the procurement. Such things as size, color, tolerance must be included to avoid any unnecessary delays. Of particular note is the need for SOLE SOURCE documentation. SOLE SOURCE refers to the requisitioners belief that the material or service can only be provided by a particular vendor. If this is in fact the case, the requisitioner must prepare a statement sufficiently documenting why no other vendor can fulfill the need.

c. QUANTITY---The amount of the service or physical good desired by the requisitioner.

d. ESTIMATED AMOUNT---The dollar amount/cost of the goods or services.

e. REQUISITIONER---The identification of the ordering unit/department which is to receive the goods or services.

f. PRIORITY---The degree of urgency associated with a given acquisition.

All incoming requests are screened by the supervisor for degree of difficulty and dollar amount. After determining these factors, the supervisor assigns each request based upon the level of knowledge of each buyer and to some degree the type of request involved, e.g. imprest fund requests and maintenance/rental agreements are typically assigned to particular buyers on a permanent basis. This

allocation process is largely subjective and is based upon the supervisor's experience and knowledge of existing backlogs on the desks of individual buyers.

Each buyer receives their assigned acquisition requests once a day, or possibly twice a day, depending upon the supervisor's ability to screen his/her incoming basket. These newly assigned requests are logged into the buyer's work-in-progress log. This log, and the individual entries contained within the log, will subsequently be utilized to produce a weekly backlog and aging report for use by the supervisor in the future assignment of new requisitions.

The order in which each buyer processes assigned requisitions is primarily dependent upon the priority associated with each requisition and secondarily upon the age. It is important to note that the workload and the priority system do at times combine to inhibit the timely processing of lower priority requisitions, i.e. it is possible for older, low priority requisitions to remain unworked simply because newly received requisitions are of higher priority. At these times the supervisor is responsible for identifying critical cases in which low priority requisitions must be given preference over high priority requisitions. When this occurs, the supervisor is in reality tasked with accomplishing the completion of both aged low priority requisitions and the timely processing of all high priority requisitions as well. In short, an increase in productivity is mandated. A delay in processing results in a degradation of the 'procurement action lead time' (PALT) attributed to a given requisition. The PALT measurement is a key indicator of system performance utilized by every purchasing activity. This indicator measures the 'wait time' experienced on every procurement request between the time it enters the Purchasing Branch until a buyer has contacted a vendor and completed the necessary action required to initiate the

actual supply of the material or service. Such a measurement is closely related to buyer backlog and the workloads upon each individual buyer. However, the PALT measurement is also effective as an indicator of overall system performance and not just the performance of a single buyer. This measurement is now being provided manually on every procurement completed to determine the average PALT for the system. It is a meaningful indicator of branch performance which management relies upon for production/planning purposes. The proposed system will compute this information internally and provide a detailed analysis on each buyer and on the system as a whole.

C. AN ALGORITHM FOR NON-STANDARD PROCUREMENTS

The following discussion is logically organized to provide a framework by which a given procurement transaction is processed. An attempt has been made to structure the discussion along algorithmic lines to facilitate an understanding of the processes each buyer must utilize when processing a single transaction.

1. Procurement of ADP Equipment

The first decision that each buyer must make, regarding the processing of a requisition is whether or not a given acquisition is for ADP equipment/service. If so, the buyer must determine from the estimated price whether or not the sum total of this acquisition will exceed $10,000. If it does, the procurement must first be approved by the Chief of Naval Education and Training (CNET). The buyer begins this process by completing a 2276 and logging the transaction in the Purchase Support Log. This log consists of the following columns:

a. Julian date on the requisitioner's request
b. Serial number on the requisitioner's request

c. Next sequential number in the log
d. Date transaction is being logged
e. Department code
f. Nomenclature
g. Activity to which this action is being referred for procurement
h. Number of different line items being procured
i. Dollar amount
j. Contract number assigned by procuring activity

Upon completion of the 2276, it is forwarded to the Chief of Naval Education and Training (CNET) for procurement authorization, and no further action is taken pending its return. Ultimately all approved requests will be forwarded to NSC Oakland for action.

2. Procurements from Other Government Agencies

If the procurement is for ADP equipment/service, but will not exceed $10,000, or if the procurement is not for ADP equipment/ services, the buyer will begin procurement action by determining whether the items requested can be provided by some source within the federal government, e.g. the Government Printing Office, Federal Prisons Industry, etc. Where possible, these sources are utilized to minimize costs to the Government. Acquisitions from these Government Agencies are accomplished on an 1155 Delivery Order citing a locally prepared contract number. This contract number is sequentially assigned from the 'F' log and is unique to each procurement. The 'F' log is composed of the following columns:

a. Julian date of requisitioner's request
b. Serial number of requisitioner's request
c. Next sequential number in the log
d. Date transaction is logged in
e. Department code

f. Nomenclature
g. Vendor is local or outside the local area
h. Tenant activity
i. Dollar amount

3. Federal Supply Schedule Procurements

If the material/service is not available from agencies of the federal government, the buyer must determine whether it can be procured on an existing contract previously established by the General Services Administration (GSA). These contracts are referred to as Federal Supply Schedules (FSS) and must be utilized when available. As in the previous example, a Delivery Order is prepared citing the vendor with which the Government has contracted to provide the given goods/services. However, the FSS number will be cited on this Delivery Order as well as the local purchase order number. As in the above example this transaction will be logged to the 'F' log.

4. Procurements Exceeding $25,000 Local Limitation

If a given aquisition cannot be filled by a Government source or cannot be provided on an existing FSS contract, the buyer must next determine whether the goods/services can be procured for less than $25,000. This is the current limitation of local procurement authority and is the determining factor as to whether a given aquisition can be contracted locally or must be referred to another contracting authority having a higher limitation. For those items in which the estimated dollar value exceeds this limitation, the buyer will prepare a 2276 and log the transaction in the Purchase Support Log. Further procurement action at the local level is suspended and the activity to which the action is referred will ultimately provide the Purchasing Branch with a copy of the completed contract.

5. Procurements Less Than $500

At this point in the processing algorithm, the buyer should have eliminated procurements in excess of $25,000. In order to continue the buyer must next determine whether the sum total of the aquisition will exceed $500, for competitive bidding processes are required for acquisitions exceeding this amount.

First, let's consider the case in which no competition is required, i.e. the cost of this transaction will not exceed $500. The buyer has two potential means of fulfilling this acquisition request, and if this transaction does not exceed $150 a third option is also available.

a. 1155 Purchase Order

The buyer may prepare an 1155 Order for Supplies or Services by selecting a vendor from the Small Business Index file. This file has been established in Federal Supply Class (FSC) order to facilitate such assignments, i.e. it is arranged by type of material supplied by the vendors. Each vendor may have more than one index card in the file if he/she supplies a wide range of material.

b. Blanket Purchase Agreement

The buyer may select a vendor with whom a Blanket Purchase Agreement (BPA) has been negotiated. This type of acquisition is by far the least costly to process in that the vendor has agreed to post all orders to an open account and provide a single itemized bill on a monthly basis. There are two possible options:

(1) The vendor agrees to provide material based solely upon a phone request from the Purchasing Branch. In this case, the buyer will pass the order to the vendor over the phone and will provide the vendor with the

BPA number and a sequential call number extracted from the 'A' section of the 'F' log. To document this transaction the buyer will prepare a DD 1348.

(2) The vendor requires a hard copy document prior to processing the order. In this case the buyer will prepare a 4270 citing the BPA number and a sequential call number extracted from the 'A' section of the 'F' log. The original is provided to the vendor to initiate the procurement.

c. Imprest Fund

In those cases in which the cost does not exceed $150 and the vendor is not a BPA vendor, the buyer may process the acquisition as an Imprest Fund order. This type of procurement is like that of a petty cash transaction in the civilian sector, i.e. the requisitioner is provided with cash to pay for the material or service and is obligated to return a paid sales voucher to the Imprest Fund Cashier, or the vendor may agree to provide the material COD. If the vendor will accept a telephone order a DD 1348 is prepared to document the transaction. If he requires a hard copy document a 4270 is prepared and mailed or hand carried. In either case the transaction is logged in the 'Y' log which contains the following columns:

(1) Julian date on requisitioner's requisition
(2) Serial number on requisitioner's requisition
(3) Current date
(4) Next sequential number in 'Y' log series
(5) UIC or department of requisitioner
(6) Description of item
(7) Vendor's name
(8) Large or small business indicator
(9) Dollar amount

6. Procurements Exceeding $500

Now, let's return to the case in which the cost of the acquisition will exceed $500. At this point the buyer knows that the cost will be between $500 and $25,000. This is the range in which the buyer is required to solicit three or more competitive bids or accept the submission of a 'sole source' statement from the requisitioner justifying the existence of a single acceptable vendor. Sole source is the exception rather than the rule and must be closely scrutinized with a view toward promoting competition as opposed to diminishing it. The burden of providing the buyer with adequate sole source justification is on the requisitioner. All subsequent processing is handled in the same manner for both sole source and competitive bidding, i.e. once the ultimate vendor has been determined, completion of the acquisition process is identical.

7. Blanket Purchase Agreements

The buyer may proceed by determining whether a particular acquisition may be fulfilled by a BPA vendor (See previous explanation of BPA process). This is accomplished by determining two things:

a. Whether the total cost of the acquisition is less than $10,000.
b. Whether the vendor in question has negotiated a BPA agreement.

If the answer to both these questions is yes, then BPA processing procedures as previously discussed are fully applicable.

8. Purchase Orders and Purchase Support Procedures

If it is determined that the cost of acquisition will exceed the $10,000 limitation associated with BPA procurements, a check must again be made to determine whether the cost will also exceed the $25,000 local contracting authority. If so, the buyer is precluded from issuing an 1155 Purchase Order and must prepare a 2276 Request for Contractual Procurement. As previously discussed, this transaction is in effect a referral of the acquisition process to an activity with a higher contracting authority. The Purchase Support Log is used to document this transaction. In the event that the acquisition in question does not exceed $25,000 the buyer is authorized to prepare a standard 1155 Purchase Order and document the transaction by logging it to the 'M' log. This log consists of the following columns:

a. Julian date on requisitioner's requisition
b. Serial number on requisitioner's requisition
c. Current date
d. Next sequential number in the 'M' log series
e. UIC or department identification number of requisitioner
f. Description of material
g. Vendor's name
h. Number of items on this order
i. Vendor's locality
j. Dollar amount

Returning again to the question of whether a given acquisition may be filled by a BPA vendor, the final issue is whether the vendor being considered has negotiated a BPA agreement. If not, the buyer has no option but to complete the acquisition by preparing an 1155 Purchase Order as previously discussed.

The preceeding sections regarding the current processing procedure were quite long and rather complicated. The following is a capsulized summary of the major categories of transactions discussed:

1. Purchase Orders---These are contractual agreements up to $25,000, which are prepared on an DD 1155. Those under $500 do not require competitive bidding prior to award. Those above $500 do require a minimum of 3 competitive bids except as noted in the chapter on material acquisition.
2. Blanket Purchase Agreements (BPA)---These types of transactions are in effect a form of charge account established by written agreement with specific vendors who have agreed to furnish material or service on account and provide an aggregated bill on a periodic basis. A contractual agreement already exists at the time a buyer receives the procurement for action.
3. Imprest Fund---These types of transactions are similar to a petty cash transaction in the civilian sector. Material may be ordered by telephone or mail for delivery COD, or the requisitioner may be provided with cash to pick-up material at the vendors place of business.
4. Orders Under Contract---Transactions of this type are affected utilizing contracts previously negotiated by another activity. A typical example might be the use of a Federal Supply Schedule (FSS) or standing contract negotiated by a higher authority. These may be referred to as a Delivery Order.
5. Maintenance/Rental Agreement---These transactions invelve the establishment of an open contract (typically long term) in which the vendor agrees to provide a piece(s) of rental equipment, and/or service

specifically denoted piece(s) of equipment for a negotiated sum of money.

6. Agreement with Civilian University---These agreements are negotiated with various civilian universities to provide for the educational services they offer to government employees pursuing courses of study at those institutions, e.g. tuition, thesis expenses, etc.
7. Purchase Support Transactions---These transactions involve procurements which exceed the small purchase limitation of $25,000. Such transactions are referred to other activities having authority to procure material and service in excess of this amount.

D. MISCELLANEOUS PROCESSING CONSIDERATIONS

The processing procedure cited throughout the preceeding scenario is sufficient to process 95% of all transactions entering the Purchasing Branch. The remaining 5% of all transactions fall into a wide range of categories. Two of the more significant warrant recognition:

1. Minority Businesses---This category includes vendors who belong to members of minority races or even minority groups such as women-owned businesses. Such businesses enjoy significant advantages over others because they are guaranteed first consideration. Simply stated, they are assured of government business if it can be reasonably assumed that they can fulfill the needs of the requisitioner and if the cost of the material or service is reasonable. Such vendors need not provide the material or service at the absolute lowest cost.

2. Small Business Set-asides---Procurements of this nature exist to promote small businesses by diminishing the

competitive forces within the market place with which these businesses must cope. This has been accomplished by 'setting aside' specific types of procurements with specific dollar limitations which may only be awarded to small businesses under the auspices of the Small Business Administration. To qualify for consideration in this program, a business must have a limited number of employees and annual sales of less than a certain dollar amount. In essence, this has resulted in limited competition between a few qualifying vendors by precluding larger vendors who might otherwise enjoy an 'unfair' economic advantage.

These special categories are not within the scope of routine processing because of a socio-political 'awareness' atmosphere within the United States which has prompted Congress to authorize these exceptions to the competitive process. Such exceptions have been recognized as being 'in the national interest', and have as a goal the enhancement of the social and political welfare of the disadvantaged.

III. PROPOSED SYSTEM SPECIFICATIONS

A. BACKGROUND

Typically, a proposed system is founded on a global process view which requires end-to-end analysis of all the activities composing the process as well as those which are directly affected by the process. This analysis has two objectives:

1. The possible redesign of the process as a whole and/or of its constituent activities, and
2. The analysis, integration, evaluation and functional design of the support facilities required for the various activities which will constitute the process.

This macro analysis view of the process may dictate modifications in individual activities or re-assignment of activities and responsibilities--since it makes no sense to automate and perpetuate an unsatisfactory process. Even good processes may need redesign to fully realize the potential of new technology, and this is entirely the case at hand. As previously stated in the section on Scope and Limitations in Chapter I, the author's proposed MIS design was to address the functional responsibilities of the purchasing activity as they are currently assigned. Indeed, re-structuring of functional responsibilities among the various branches of the Supply Department was to be avoided. This aspect of the author's charter has curtailed complete optimization of system performance in that the purchasing function, as it is organizationally defined, does not include status follow-up responsibilities or invoice certification and payment. The incorporation of these functional

responsibilities would facilitate the development of other forms of management information and greatly enhance the cost effectiveness of the system. For example, the vendor selection process could benefit greatly from feedback information available subsequent to material receipt and inspection. Feedback loops might be established whereby punctuality and merchandise quality, could be monitored on all vendors. Feedforward information to receiving personnel would facilitate the process of material identification in the receiving area and improve management control of 'frustrated', undeliverable material. A similar feedforward mechanism could be employed to alert invoice certification personnel of the receipt of material and thus provide a 'tickler file' of work in process. Such a system would preclude delays in invoice certification by highlighting the lose of receipt paperwork.

Obviously the scope of any system can continue to be broadened almost indefinitely, but at some point such systems cease to be purely informational in nature and begin to take on the role of transaction processing systems. As stated previously, this was not the intent at the outset of this study. The author has therefore tried to design a system which provides only management information. The criteria utilized to decompose the existing system and develop output reports for management purposes are depicted in Table I The data elements which must be captured to provide this information will be discussed in a subsequent section.

B. SYSTEM ORGANIZATION

The proposed system is composed of a logical compilation of transactions which document the various steps in the procurement lifecycle. As a given procurement request

TABLE I

System Development Criteria

1. Types of Procurements	5. Work-in-Process
2. Method of Procurement	6. Aged Backlogs
3. Contractor Size	7. Referrals
4. Procurement Action Lead Time	8. Customer Mix

evolves from the initial entry phase to the assignment of a solicitation number and the eventual award of a contract, its progress will be documented utilizing specially designed transaction coded input to capture each change in life cycle state. System input will be edited and stored for daily batch updating of the data base since there is no need for real-time updating or on-line query capability. Additional discussion of this aspect of the system will be provided in separate section referring to the update process. A series of application programs must be designed to perform the above functions and provide the necessary output reports.

1. Input

The proposed system will accept input via a single programmable CRT terminal capable of input edit functions and forms generation. This terminal will be located in the Purchasing Branch and will be utilized to establish the initial record of each procurement request and to update each record with new information developed as a result of the procurement process. The initial record of each requisition entering the system will be input by a

control-clerk/typist utilizing a unique transaction coded entry. Appendix A contains the information associated with this input transaction. It is in essence a skeletonized record containing only the barest essentials. However, foremost among these essentials is the assignment of a specific buyer who is responsible for the 'cradle-to-grave' processing of the requisition. This key element will be utilized extensively to establish responsibility for a given procurement and to provide a sort key for many of the proposed output reports.

As a given transaction progresses through the procurement process, its life cycle will be documented at each significant change in state. Following initial entry into the system, a specific buyer will begin the task of procuring the needed material. As discussed in the previous chapter, this is a complicated process subject to many rules and regulations. Depending upon the type of material, the dollar value of the procurement, and the existence of purchase agreements with numerous venders, the ultimate path to receipt of material may be quite variable. However, this entire process can be captured utilizing six transaction codes to represent the various stages of the procurement process. Table II contains a brief, general purpose description of each of the these transaction codes. A detailed discussion is provided in subsequent sections.

As stated previously, input is accomplished utilizing a programmable CRT terminal, and due to the relatively small volume involved, a single terminal will suffice. This single terminal will provide each buyer with a skeletonized display of the particular transaction code he/she wishes to enter simply by typing in the desired code number. All required and all optional data entries relating to a specific transaction code would be clearly depicted on the CRT screen, and all input typed on the CRT screen would

TABLE II

Summary of Transaction Codes

CODE	GENERAL PURPOSE
1	Establish a newly received requisition in the system
2	Assign solicitation number
3	Assign contract number and complete procurement record
4	Make selected changes
5	Cancel a requisition
6	Refer requisition to another procurement activity

be clearly visible to the person inputting the information. Any errors would be readily apparent to the user. Actual input into the data base would not occur as an immediate result of key entry on the terminal. At the time of key entry, all data provided by the user would be edited by the programmable microprocessor resident inside the terminal. Invalid entries would cause the entire transaction to be rejected for immediate correction by the person who input it. This procedure insures that all input is accurate with regard to format and data type. It also greatly enhances to probability of correction and resubmission of invalid input.

According to Gessford, "The decentralization of data input operations and the integration of data input into the job routines of the user group has in some cases reduced the cost and improved quality at the same time, contradicting the apparent cost-quality trade-off concept and showing the

overriding importance of employee motivation.... each data input system should be controlled and operated by user personnel, not by a centralized key-entry department. This means that data input systems should be built on teleprocessing systems that include terminals at user locations. The old centralized batch system in which users submit typed, or handwritten, documents to a centralized keypunch department does not give the user sufficient control over input data errors made by that department." [Ref. 1 : p.137]. Given the relatively small volume of transactions to be entered (approximately twenty per buyer per day), the author is in full agreement with Gessford's input strategy. By coupling this strategy with the enhanced capabilities of the 'intelligent' programmable terminal, it is anticipated that significant improvements in error detection and correction turn-around times are possible.

The following subsections contain a more detailed discussion of the function of each transaction code listed in Table II Appendices A through F provide further guidance regarding the data elements applicable to each code.

a. Record Establishment

In the proposed system each requisition would begin the procurement process by being loaded into the system utilizing a 'TC1' transaction code. Only the very basic elements relating to each requisition would be captured at this point, i.e. the document number, the date received, the priority, and the code of the buyer assigned. In this system the TC1 would be entered by a clerk-typist utilizing a data input/output terminal. This input function could also be performed utilizing a keypunch machine and cards if necessary. However, such systems have become outmoded, given the high cost of card stock and the expense of renting and maintaining mechanical keypunch and card

reader devices. The relatively small rental expense of a terminal and the on-line edit functions which they can provide makes it the most cost-effective method for inputting information.

b. Completion of the Procurement Record

Upon completion of the initial input process, utilizing the TC1 transaction code, the clerk-typist would forward the requisition to the designated buyer. An automated record of the requisition would now be resident in the data base and the existence of the procurement action in a buyer's backlog would be visible to the supervisor. In addition, the Procurement Action Lead Time (PALT) 'clock' would begin running at the time the TC1 was entered. At this juncture the buyer would be responsible for all further processing. Table II depicts the various options available to the buyer. Typically, for transactions amounting to less than $500, the buyer would select a vendor and enter a 'TC3' transaction code via the terminal thereby completing the procurement process. For procurements exceeding $500, the buyer would enter a TC2 documenting the solicitation of bids from various vendors and updating the transaction record with the solicitation number. Following the responses from the vendors and the selection of the winning vendor, the buyer would enter a TC3 to complete the procurement. During all phases of the life cycle of a given procurement, the supervisor and buyer could be provided with hard copy progress reports. More appropriately, they should be provided with daily exception reports listing those procurements which exceed expected processing timeframes. Such reports would warrant close scrutiny by the supervisor to better establish priority processing efforts for the workforce.

c. Referrals

In addition to routine processing utilizing TC1, TC2 and TC3 entries, the buyer might, depending upon the money value or special nature of the procurement, be required to refer the requisition to another purchasing activity. These procurements would be entered utilizing a TC6 transaction code and would document the Unit Identification Code (UIC) of the new activity having procurement responsibility. As these activities issue contracts in fulfillment of their responsibilities, they are required to forward information copies to the initiator of the request. These copies would be received by a clerk-typist and entered into the MIS utilizing a TC3 to document completion of the procurement. Again, exception reporting on overaged referrals should be generated.

d. Changes and Cancellations

TC1, TC2, TC3 and TC6 transactions compose what would be termed 'standard processing procedure'. However, some facility must be built into the proposed MIS to allow for changes or cancellations to procurements previously entered into the system. The TC4 and TC5 have been proposed for these purposes. The TC4 transaction code provides the buyer with the capability to change, by overlaying, all previously input information except the original document number provided by the customer. To change the document number, assuming it was entered in error, the buyer would first have to cancel the erroneous record utilizing a TC5 cancellation. The correct document number would then be re-entered utilizing a new TC1 entry. This double input procedure is proposed as a safeguard to preclude the inadvertent alteration of correct TC1 entries. Any buyer who wished to correct an erroneous document number would be

required to input two separate transactions. The TC5 cancellation would require the positive selection and input of a reason code for the cancellation. In addition, each TC5 entry would generate a detailed cancellation listing for supervisory information.

2. Update

As proposed by the author, the new MIS will be updated on a daily basis with the validated input discussed in the preceeding section. The update process would utilize an application program designed to post input transactions to a master file containing information on all active and completed procurements not yet purged. New records would be opened in the file for newly received procurements. New information, documenting a change in an already existing record, would be added to the file. It is important to keep in mind that this information has already been validated for errors in format during the input process and the user should not expect many, if any, update errors.

The system has been designed as a batch update system after careful analysis of the daily business routine. The author found no evidence that real-time updating of the data base is necessary. This is true primarily because of the processing procedure already in use whereby a single buyer has 'cradle-to-grave' control of each individual procurement. Given the relatively small number of transactions being processed during the day, any inquiry regarding a given requisitions status is easily answerable if a change has recently occurred. Procurements for which no change in status has taken place will be accurately reflected on the previous days output reports. Information regarding the status of procurements as of the preceeding day is considered more than adequate for workload and backlog analysis purposes. Real-time updating of the data

base and on-line inquiry capabilities are totally unnecessary and will only add to the cost and maintenance problems associated with the system.

As in any system, the correct sequencing of transactions is paramount to the successful posting of input. In the proposed system, sequencing will be accomplished on two levels. First, only one buyer will be responsible for the 'cradle-to-grave' processing of a given procurement after its initial entry into the system. This should insure a degree of continuity to the input transactions in that a buyer would not logically attempt to complete a procurement without first opening a record for the procurement. Likewise, a buyer would not logically attempt to refer a procurement to another activity if the contract had been awarded locally. To preclude human error in which this logical procedure might be violated, a second, positive control feature would be incorporated in software to insure the proper sequencing of transaction codes when used in conjunction with a batch update procedure. Table III depicts the proposed priority for processing the various transaction codes into the system. Input data would be physically sorted prior to posting to insure compliance with this table.

The update process discussed thus far pertains to the updating of the data base with new information. However, as in any system some means of purging inactive, completed procurements from those still active and pending procurement action is required. The author proposes a monthly purge of the master record file in which all records containing a TC3 or TC5 entry are deleted from the master record and moved to a history file of completed procurements. Both the TC3 completion and the TC5 cancellation would be considered end-of-work-in-process inputs, and by moving such records to a history file the inexorable growth of the master record

file would be precluded. Given the 1,000 new procurement requests each month and the need to prepare periodic hard-copy reports of all active procurements, this purge process seems most appropriate. This is especially true in light of the considerable number of sort passes which will be required to produce tailored listings by buyer code and document number. It is absolutely imperative if the system is to remain compatible with microcomputer technology.

C. REPORT GENERATION

The proposed MIS is basically a monitoring tool designed to record, track and document the receipt, progress and award of purchase requests. It originates when the requisition is first received in the Purchasing Branch and is continuously updated by the buyer to reflect the most recent

TABLE III
Transaction Code Processing Priority

PROCESS PRIORITY	CODE
1.	TC1
2.	TC2
3.	TC6
4.	TC3
5.	TC4
6.	TC5

status of each procurement request. Once recorded, the requisition is monitored through the buying cycle. When a solicitation number is assigned, the system is updated. When referral actions are taken or revisions are made the system is updated, and when the requisition is awarded or cancelled the system is updated. Each of these updates are reflected in hard copy output reports designed to provide management and individual buyers with information regarding their performance. To assist in the analysis of these reports a detailed description of data elements contained within them is provided in Appendix G.

1. Daily Reports

As proposed, the system would generate most reports on a request basis. That is, to request a report, the user would simply enter a special report identifier code into the batch update. Naturally, some reports would be requested more frequently than others. The following subsections describe the daily reports produced by the system.

a. Daily Listing of Update Transactions

The Daily Listing of All Update Transactions would generate a hard copy of all transactions entered in the update. It would be output automatically without request. This listing would become a permanent record of all transactions processed in a given update and thereby provide an audit trail and/or means of identifying and correcting transactions which may have been entered erroneously. It would appear as an 80/80 image of the input transaction. A typical daily update would contain:

(1) 48 transactions to establish new records
(2) 9 transactions to establish solicitation numbers
(3) 48 transactions to establish contract/order numbers
(4) 8 transactions to document changes to existing records

(5) 1 cancellation transaction

(6) 1 referral transaction

b. Detailed Listing of Active Procurements

This listing contains a detailed record of all procurement requests currently held in the system. It is in document number sequence and provides the user with a means of cross-referencing specific procurements to the buyer assigned. Currently no such system exists. Based upon monthly receipts of 1,000 new requisitions and an average PALT figure of 13 days, this listing would generate approximately 1624 lines of output. See Figure 3.1.

c. Daily Summary of Work Processed/Current Backlog Report

The Daily Summary of Work Processed/Current Backlog Report would contain a summary of the previous days work and the current backlog. It would present aggregated totals only and would not address individual buyer statistics. See Figure 3.2.

d. Daily Completions/Cancellations Report

The Daily Completions/Cancellations Report would be sorted by buyer code and would contain a total count by buyer of all TC3 and TC5 transactions posted during the update. It would also list the total number of new receipts by buyer. See Figure 3.3.

e. Daily Customer Mix Report

The Daily Customer Mix Report would provide information on individual customers. It would be sorted by UIC for external commands and by document serial number for internal departments and divisions. This report would list the total number of procurement actions received from each

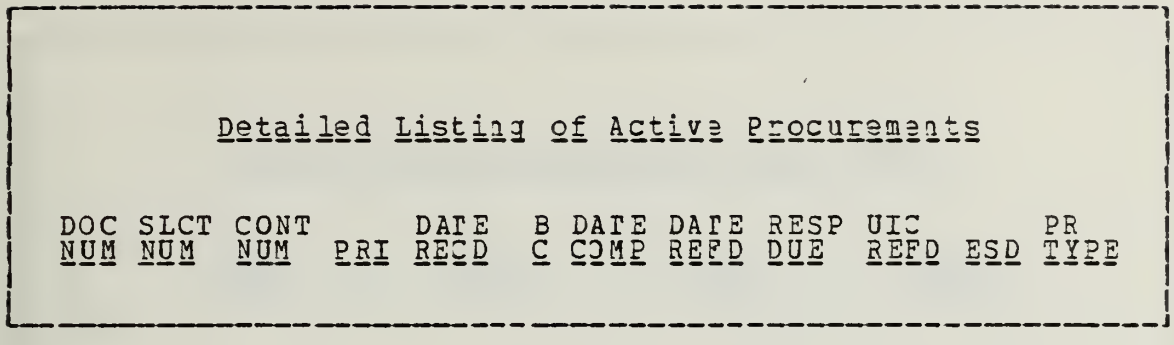

Figure 3.1 Detailed Listing of Active Procurements.

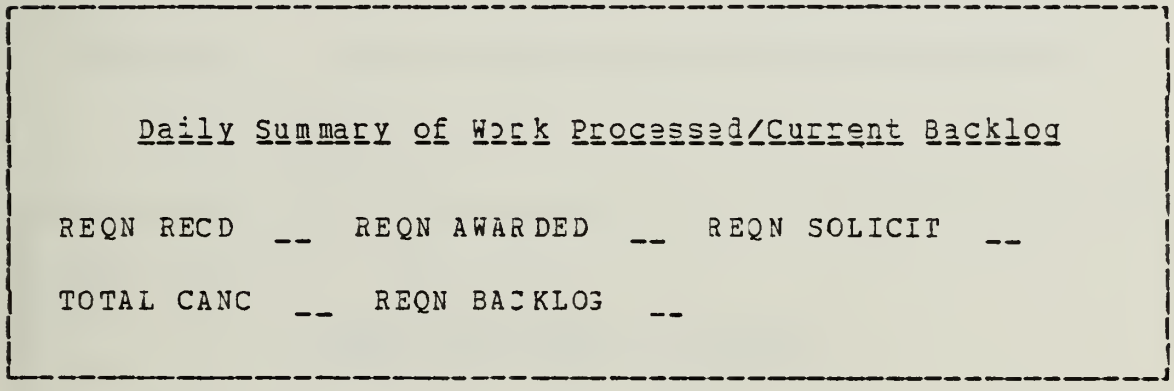

Figure 3.2 Daily Summary of Work Processed/Current Backlog.

customer, each customer's percentage of the total workload volume, the total number of procurements awaiting completion by customer, each customer's percentage of the total volume awaiting completion and the average PALT by customer. See Figure 3.4.

f. Daily Work-in Process Report

The Daily Work-in-Process Report will be a principle working document depicting each buyer's workload/backlog status in detail. Its primary sort would be by buyer code. Within buyer code each transaction would be

Daily Completions/Cancellations Report

BC	TC3 (COMP)	TC5 (CANC)	TOTAL	TC1 (RECD)
01	8	1	9	1
02	2	0	2	2
03	3	4	7	6
TOTAL	13	5	18	9

Figure 3.3 Daily Completions/Cancellations Report.

Daily Customer Mix Report

UIC	REQN RECD	% REQN	TOT REQN	% REQN	PALT
04629	55	96	300	94	20
05119	2	4	20	6	19
TOTAL	57	100	320	100	

Figure 3.4 Daily Customer Mix Report.

listed by document number together with the date it was received, the priority, the solicitation number, the date referred if applicable, and the anticipated referral response date if applicable. At the bottom of each buyer's portion of the report, an aggregated total of all

Daily Work in Process Report

B C	DOC NUM	SOLT NUM	DATE RECD	DATE REFD	RESP DUE	PRI

BUYER TOTAL EXCEEDING 30 DAYS OLD: XXX
BUYER TOTAL PROCUREMENTS REFERRED: XXX

Figure 3.5 Daily Work in Process Report.

transactions exceeding 30 days old and an aggregated total of all referrals should be displayed. This listing would average 624 lines in length based on a 13 day PALT. See Figure 3.5.

g. Report of Purchase Transactions on Referral

The Report of Purchase Transactions on Referral is a detailed list of all active referrals (TC3 or TC5 not posted) sorted by document number. It contains the buyer code, the date received, the date referred, the anticipated response date and the priority. See Figure 3.6.

2. Monthly Reports

Equally important, but less frequently required, would be information designed to assist management in the preparation of external as well as internal reports to superiors. Typically, these reports deal with longer term analysis and are used for long term production and planning purposes. The following reports would be provided on a monthly basis or more frequently, if desired.

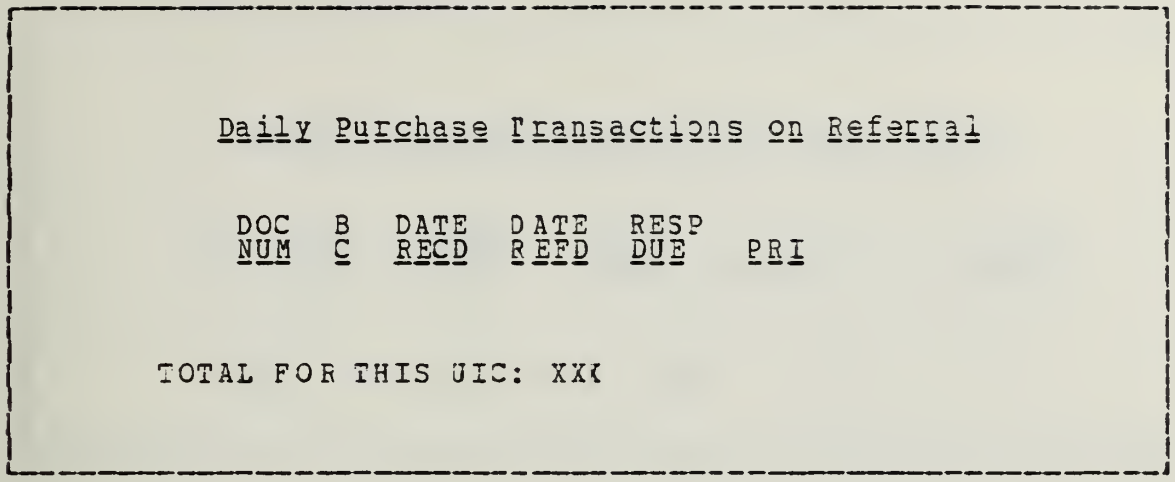

Figure 3.6 Daily Purchase Transactions on Referral.

a. Monthly Customer Mix Report

The Monthly Customer Mix Report is similar to the Daily Customer Mix Report discussed in the previous section. However, it would contain an aggregation of one month's transactions as its name implies.

b. Monthly Completions/Cancellations

The Monthly Completion/Cancellation Report would be similar to the daily report discussed in the previous section. It would contain a monthly aggregation by buyer code and in addition would be secondarily sorted by purchase type in recognition of the different production rates attributable to each type of procurement, i.e., some types of purchases are easier to effect than others. See Figure 3.7.

c. Monthly Referral Analysis Report

The Monthly Referral Analysis Report would provide management with information regarding the rate at which each specific customer's requests are referred to

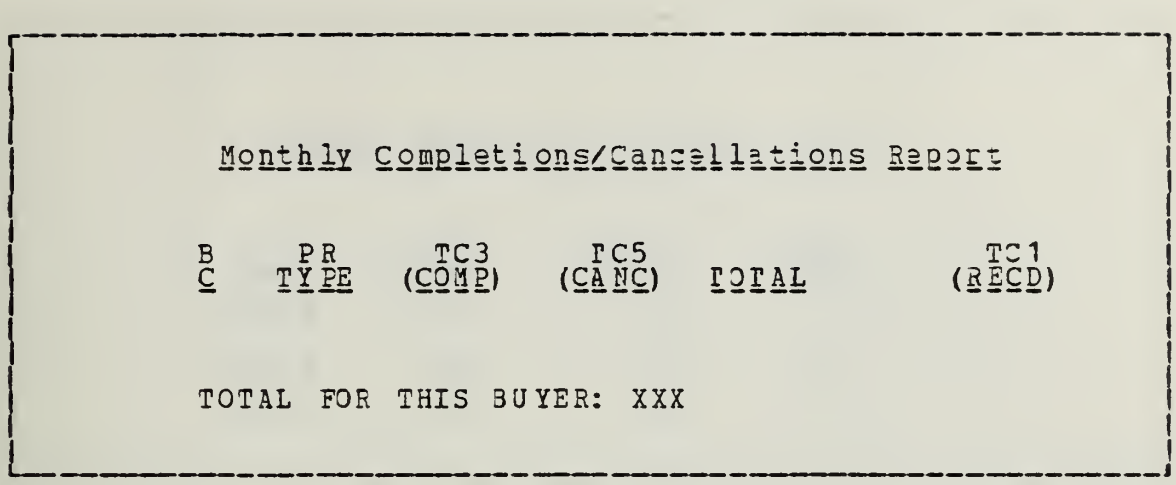

Figure 3.7 Monthly Completions/Cancellations Report.

other purchasing activities for action. It would be sorted in customer order and would contain the total number of requisitions awaiting action by a referral activity, the total number of requisitions held in the system (referrals plus non-referrals), and a percentage referral rate determined by dividing the former by the latter. See Figure 3.8.

d. Monthly PALT Report

The Monthly PALT Report will be key indicator of purchasing performance. This report will be stratified by purchase order, delivery order, imprest fund, BPA and contracts. It will list the monthly total of completed procurements under these headings. In addition, the PALT for each of these headings would be listed by computing the difference between the date of receipt and the date of completion on each transaction. See Figure 3.9.

e. Monthly DD 1057 Report

The Monthly DD 1057 Report is a summary of all transactions of $10,000 or less. It is stratified into various sections which address contractor size, purchase

Monthly Referral Analysis Report

UIC	TOT REQN	TOT REFD	% REFD
04629	1000	50	5
05119	100	10	10
TOTAL:	1100	60	6

Figure 3.8 Monthly Referral Analysis Report.

Monthly PALT Report

	TC3 (COMP)	AVG PALT
BPA	100	10
IMPREST	50	12
PUR ORDER	75	20
DEL ORDER	2	30
CONTRACT	1	30

Figure 3.9 Monthly PALT Report.

method and purchase type. For purposes of the proposed output report, the output data should be listed by line item corresponding to the appropriate line on the actual DD 1057. Each line would contain a total for the actual number of requisitions processed to completion (TC3) during the month, and a total dollar value for the month. See Figure 3.10.

Monthly DD 1057 Report

SECTION	LINE	COMP ACTIONS	DOLLAR VALUE
A	1	119	96,086
A	1A	0	0
A	1B	119	96,086
A	2	705	178,568
A	2A	13	803
A	2B	692	177765
B	1A	0	0
B	1B	35	1085

Figure 3.10 Monthly DD 1057 Report.

f. Monthly NAVSUP Form 80 Report

The Monthly NAVSUP Form 80 Report would contain purchase statistics for use by the Naval Supply Systems Command. Like the DD 1057 report previously discussed, it would stratify purchases according to various headings and subheadings. Each line of the actual report has a unique number associated with it for automated reporting purposes. Some of the headings and subheadings are small purchase by procurement type, purchases referred to other activities, non-competitive purchases, PALT, beginning work in process, receipts, cancellations, completions, and ending work in process. The proposed MIS is designed to assist management by capturing the data elements necessary to automatically generate the total count and dollar value associated with each of these headings. See Figure 3.11.

Monthly NAVSUP Form 80 Report

LINE	ACTIONS	DOLLAR
01	157	40,000
02	48	140,000
03	7	8,000

Figure 3.11 Monthly NAVSUP Form 80 Report.

g. Monthly History Report

The Monthly History Report would contain a detailed listing of all completed or cancelled procurements purged from the system during the monthly update. Appearance on this listing would mark the end of the transaction life cycle, and as such would warrant retention of this listing for audit trail purposes. This listing would contain approximately 1,150 lines of output each month. See Figure 3.12.

D. DATA ELEMENT SELECTION

The identification of specific data elements needed in an information system is deduced by studying the information needs of management. This information when transformed to a machine-readable form, and organized according to prescribed conventions is called a data base. The contents of the proposed data base is really the result of considerable analysis of the work site and the routine processing procedure. The information it contains has been screened against the myriad of possible data elements associated with the

Monthly History Report

DOC NUM	SOLT NUM	CONT NUM	DATE RECD	COMP DATE	ESD	PRI	B C	PR TYPE	PR MTHD	DOL VAL

Figure 3.12 Monthly History Report.

purchasing process and found to have a highly positive correlation with the type of information which procurement managers need. Primarily, it contains all the data elements necessary for external reporting purposes, however, it also provides additional elements of particular interest at the local level, e.g. buyer code, reason for cancellation, referral UIC, etc. Each of the elements is absolutely necessary to the proper functioning of the proposed system and are required for the production of the proposed output reports. To assist in the development of the data base and to avoid misinterpretation of data elements, a data element dictionary (DED) has been incorporated into Appendix G.

Analysis of the work site and the manual processing procedures revealed the existence of broad areas in which management control can be enhanced. The primary problem facing management is a lack of timely information regarding the real-time state of the Purchasing Branch. That is, the supervisor is only aware, in any positive sense, of the inputs to the system and lacks daily production and backlog information with which to analyze the efforts of individual buyers. This is true because of the labor intensive nature of most data collection systems and the demand which they place upon scarce productive resources. The single control

system currently in use is a local form completed by each buyer on every procurement. Known as a Supply Department Purchase Statistics Form, it is composed of a series of boxes which the buyer annotates to reflect the categories pertaining to a given procurement. The data elements contained on the form are those necessary for external reporting purposes and thus have direct application to the type of management information developed within the proposed automated MIS. With only slight modification, this form will be ideal for use in conjunction with the proposed MIS. The data elements listed on the form could be easily augmented with the balance of the additional elements contained in Appendix G. All of the elements required by the proposed MIS would then be present on the form. This would provide each buyer with a written record of each of the days transactions, which could then be utilized, at the convenience of the buyer, for key entry at the input terminal. Continued use of the form would also provide a secondary or parallel data collection mechanism for use when and if the automated system became inoperable.

The quality of information derived from any data base is directly related to the quality of the data base itself. For this reason considerable time and effort have been expended in the selection of the elements which it contains. With good administration, the elements found in Appendices A through G will provide all the flexibility needed for future development.

IV. SYSTEM SIZING

A. INPUT

Data input is critical to the design of any system. According to Gessford, the success of the system depends upon the quality of input data as defined by accuracy, completeness and timeliness. These three attributes must be properly integrated to insure the potential acceptability of the output module. The author partially addressed the issue of data completeness in a prior section on data element selection, wherein the key elemets impacting upon management decision making were proposed for data capture (See Appendix G). However, any discussion of completeness must also address the issue of input requirements imposed by the system design. In short, a measure of input volume, as dictated by the scope of the proposed data elements, is necessary to properly 'size' the system. The primary factors impacting upon this analysis are:

1. The number of transactions to be processed
2. The number of characters per transaction

The number and types of transactions to be processed have been determined by survey of the work site. The number of characters input for each type of transaction is computed in Table IV. A summary is provided in Table V. Admittedly, such an analysis is only an estimate, but it is sufficiently accurate to formulate a general impression of the relative hardware requirements, i.e. microcomputer, minicomputer or maxicomputer.

TABLE IV

Monthly Input Requirement Detail

INPUT	DATA ELEMENT	CHARACTERS
Reqn Recd (TC1)	Service Code	1
	Document Number	13
	Julian Date Recd	4
	Priority	2
	Buyer Code	2
	Transaction Code	1
	TOTAL	23
Assign Solicit Number (TC2)	Service Code	1
	Document Number	13
	Solicitation Number	14
	Buyer Code	2
	Transaction Code	1
	TOTAL	31
Contract Award (TC3)	Service Code	1
	Document Number	13
	Contract Number	14
	Julian Date Completed	4
	Estimated Delivery Date	4
	Buyer Code	2
	Contractor Size	1
	Purchase Type	1
	Unpriced Purchase Order	1
	Total Price	7
	Purchase Type	1
	Competition/Noncompetition	1
	Transaction Code	1
	TOTAL	51
Selected Changes (TC4)	Service Code	1
	Document Number	13
	Contract/Solicit Number	14
	Priority	2
	Buyer Code	2
	Estimated Delivery Date	4
	Contractor Size	1
	Purchase Method	1
	Mod. of Dollar Value	1
	Dollar Value	7
	Unpriced Purchase Order	1
	Purchase Type	1
	Competition Code	1
	Transaction Code	1
	TOTAL	50

With regard to hardware, it should be apparent that many possible combinations of input components exist. Indeed, no single input hardware 'package' may be ideal, and two quite diverse combinations may provide the same level of marginal return.

TABLE IV
(Cont'd)

Monthly Input Requirement Detail

INPUT	DATA ELEMENT	CHARACTERS
Cancellation		
(TC5)	Service Code	1
	Document Number	13
	Julian Date Cancelled	4
	Buyer Code	2
	Reason For Cancellation	1
	Transaction Code	1
	TOTAL	22
Referral		
(TC6)	Service Code	1
	Document Number	13
	UIC of Referral Act.	5
	Julian Date Referred	4
	Response Due Date	4
	Buyer Code	2
	Transaction Code	1
	TOTAL	30

TABLE V

Summary of Total Monthly Input Requirements

INPUT	TRANSACTION/ MONTH	CHARACTER/ TRANSACTION	TOTAL CHARACTER
Reqn Recd	1,000	23	23,000
Assign Solict	175	31	5,425
Contract Award	1,000	51	51,000
Changes	150	50	7,500
Cancellations	10	22	220
Referrals	11	30	330
TOTAL	2346		87,475

Here again the concept of system design is relegated to a series of trade-offs which must be quantified in terms of overall system performance. The resultant integration invariably retains an element of subjectivity.

B. OUTPUT

The output function is the most visible portion of any MIS, and without it, all else is irrelevant. Several options are available to the designer. The two most common are terminal and printer output. Each has advantages and disadvantages. For purposes of the proposed system, a slow line printer or even slower serial printer would provide hard copy output quickly and at relatively low-cost. The principle disadvantage of hard copy output is the volume of bulky paper reports which must be filed. To partially

alleviate this problem, the author proposes that hardcopy reports be generated only on request. CRT terminal output is more convenient but has limited display capacity and no hard copy capability to provide for long term access or audit trail maintenance.

The output, as proposed, consists of seven daily and seven monthly report listings. This volume is not large in terms of overall system capacity, i.e. data access/retrieval time, buffer capacity, print time, etc. For this reason many hardware options remain open to the user. In order to permit evaluation of these alternatives, output requirements are estimated in lines and characters and are exhibited in Table VI and Table VII As evidenced by these requirements and those in Tables IV and V, the size of the system is still within the scope of a large microcomputer system.

C. STORAGE

In assessing the storage requirements of the system, consideration must be given to storage volume, access time and the record format being utilized. The latter factor is heavily dependent upon the programming language and the skills of the individual programmer. As proposed by the author, this system would be implemented in COBOL or a similar language wherein a continuous fixed length record is established for each requisition which enters the system. The file of records would be logically arranged in document number sequence and each transaction affecting a given record would merely post to the appropriate field of the record or, in the case of changes, overlay already existing information. More elaborate file structures are common today utilizing data base management systems (DBMS); however, the relatively small size of this system and the few number of users does not warrant the large expense of

multiple file types or a DBMS. According to Hussain [Ref. 2 : p.204], as much as 500,000 characters of main memory may be necessary to support a DBMS, and three times more extra disk memory is required for a DBMS than for an MIS without a DBMS. As stated in the opening remarks, low cost is a factor in the system design. To remain within the scope of microcomputer technology consideration of a DBMS is inappropriate. Such a system would require all of the main memory just to support the DBMS, and depending upon file structure, the memory requirements of the data base itself could conceivably be increased. According to Hussain, a DBMS is generally indicated when a firm needs at least three of the following:

1. An integrated data environment
2. Rapid retrieval of data from large files
3. A query/update language for use at terminals
4. Sophisticated backup and recovery procedures
5. Elaborate privacy/security protection
6. Handling of complex data structures.

Since the proposed system does not meet any of the above criteria, the author has elected to use the traditional application programming package (APP) approach. That is, "...A system of computer programs...that formulate routine data requests, supply the requests, input and edit new data, update existing data, calculate and summarize data, and produce various output documentation all in its own peculiar fashion. The data items in storage are organized in a manner that makes sense for the particular application" [Ref. 1 : p.96]. Given the range of the proposed reporting system, considerable sorting of the master data file will be necessary which will make the system quite sensitive to access times and volume.

TABLE VI

Analysis of Daily Output Reports

OUTPUT	LINES DATA	LINES OVERHD*	LINES TOTAL	CHARACTERS PER LINE	CHARACTERS TOTAL
Update Trans					
Regn Recd	48	0	48	23	1104
Solicit.	9	0	9	31	279
Contracts	48	0	48	51	2448
Changes	8	0	8	50	400
Cancel.	1	0	1	22	22
Referrals	1	0	1	30	30
Active Procurements	1624	243	1867	72	134424
Work Processed	2	1	3	52	156
Completion/ Cancelled	5	1	6	26	156
Customer Mix	60	9	69	21	1449
Work in Process	624	94	718	44	31592
Trans on Referral	11	1	12	30	360
TOTAL	2441	349	2790		172420

*Headings, Totals, etc.

TABLE VII

Analysis of Monthly Output Reports

	LINES			CHARACTERS	
OUTPUT	DATA	OVERHD*	TOTAL	PER LINE	TOTAL
Customer Mix	60	9	69	21	1449
Complt/Canc	30	4	34	19	646
Refferal Anal.	60	9	69	15	1035
PALT	5	1	6	10	60
DD 1057	47	7	54	15	810
NAVSUP FORM 80	36	5	41	14	574
History Rpt.	1000	150	1150	67	77050
TOTAL	1238	185	1423		81624

*Headings, Totals, Etc.

Any storage device installed in the system must provide sufficient capacity to store all data which need to be stored, and it must be able to access the data in a time frame consistent with the application under consideration. The storage requirements for the proposed system are exhibited in Table VIII.

As proposed by the author, there is only one file in the system. It is known as the master file and is composed of approximately 2000 fixed length records, each of which is 91 bytes in length. Each record in the file is known as a master record and is logically arranged in document number sequence within the file. Appendix G details the elements contained in each master record and provides a character count by element. The sum total of all characters depicted

TABLE VIII

Monthly Disk Capacity Requirements

STORAGE

FILE	RETENTION CYCLE	RECORD LENGTH	NUMBER RECORDS	VOLUME BYTES
Master Rec	1 month	91 bytes	2000	182,000

ACCESS TIME

Assume 1 access on average for every transaction input.

Assume 1 access on average for each line of output.

(2346 Lines Input/Month) X 1 Access (Table V)	=	2,346
(2790 Lines Output/Day) X 21 Days X 1 Acc. (Table VI)	=	58,590
(1423 Lines Output/Month) X 1 Access (Table VII)	=	1,423
Total Accesses/Month		62,359

within Appendix G is 90, however, the author has elected to add an additional byte of data in Table VIII to allow for flag bits needed in application programming. Each master record contained on the master file is therefore 91 bytes long.

D. SUMMARY

The possibilities for configuring a system are endless. It is useful, therefore, to think in terms of standard classes of equipment into which most specific items fall quite readily. For example, storage devices may be

categorized by speed of access and storage volume parameters. Two classes of disks come to mind: 1) the floppy disk, and 2) the hard disk. The former has distinct advantages with respect to portability but can not approach the access speeds and total storage volume capacities of the hard disk drive. These broad classes of devices are the kinds of decision criteria which must be thoroughly researched before deciding upon specific vendor models.

Before proceeding to draw conclusions from the sizing analysis conducted in the previous sections, a summary of the information contained in those sections seems appropriate. Table IX provides the reader with a capsulized view

TABLE IX
Summary of Monthly System Requirements

FUNCTION	REQUIREMENT	25% CORRECTION	TOTAL
Input	87,475 CPM	21,869 CPM	109,344 CPM
Output (21 Days)	58,590 LPM or 3,620,820 CPM	14,647 LPM or 905,205 CPM	73,237 LPM or 4,526,025 CPM
(1 Month)	1,423 LPM or 81,624 CPM	355 LPM or 20,406 CPM	1,779 LPM or 102,030 CPM
Storage	182,000 BYTE	45,500 BYTE	227,500 BYTE
Accesses	62,359	15,590	77,949

*CPM equals Characters/Month
*LPM equals Lines/Month

of requirements associated with the proposed system. As stated at the outset, the figures determined by this analysis are estimates, and allowances should be made for unforeseen errors, potential design changes and growths in volume. Table IX, therefore, contains an added 25% safety margin in each of the estimated requirements.

Given the data depicted in Table IX, it is now possible to determine the kind of system which is suitable for the Purchasing Branch application. As in all of the previous discussion, the best approach is to attempt to answer the questions of component size and performance characteristics by subdividing the analysis into input, output, storage and access time.

1. Input

From Table IX, we know that some 109,344 characters will be input each month. Since we have previously proposed to capture input utilizing a single programmable terminal it seems apparent that some analysis of the capacity of the terminal to handle this workload is necessary. Given that the average rate of input in this mode is about 200 characters per minute, some 547 minutes, or about 9.1 hours per month will be required for data entry. An additional small fraction of this time (5%) could also be expected for validation error detection correction and resubmission. From these figures the reader can now be reasonably assured that a single programmable input terminal will successfully handle the expected volume of transactions.

2. Output

From Table IX, it is known that 75,016 lines will be output each month. Since the proposed system will rely upon hard copy printed reports it must be determined whether a single printer or multiple printers will be required. A

typical line printer has a working speed of 100 lines per minute. Such a printer would dispose of the expected monthly workload in a 750 minutes, i.e., about 12.5 hours per month. A less formidable printer, such as a 'daisy wheel', can print at approximately 55 characters per second. It would dispose of the proposed workload in approximately 84,146 seconds, i.e., about 23.4 hours per month. Given the approximate times required by each printer, it is apparent that either will suffice, and that the options available for the proposed system are not constrained by print times.

3. Storage

The storage requirements depicted in Table IX are 227,500 bytes. Such a system is well within the bounds of current microcomputer technology. Indeed, a small microcomputer equipped with a single floppy disk drive would provide adequate secondary storage capacity for this system. As for main memory capacity, a system having only 64,000 bytes would more than accommodate the operating system and any foreseen application programming. Storage capacity alone however, does not adequately address the issue, for access time plays a significant role in the selection of storage devices.

Table IX indicates that 77,949 accesses will be required each month to support the input and output workload. Given typical average access times of 300 milliseconds for floppy disks and 87 milliseconds for hard disks, access time per month would come to about 6.5 hours for the floppy and 1.9 hours for the hard disk system. Either of the two disk technologies would be adequate for the proposed system.

V. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

The purpose of this study has been to develop a proposal for the implementation of an automated Management Information System (MIS) at the Naval Postgraduate School purchasing activity. To accomplish this purpose, a survey of operations and the volumes of data associated with those operations was conducted. From these data, the input, output, storage and memory requirements of the system were derived. A brief list of the key areas and issues that were developed in this study is as follows:

1. How is the manual processing system organized and what functions does it perform?
2. What are the key indicators of system performance upon which management relies? Can additional performance indicators be developed?
3. What data elements must be captured to provide the necessary management information?
4. How can an automated system be developed to provide management information?
5. How 'large' would an automated system be?

B. CONCLUSIONS

Conclusion #1

The current manual information collection procedure within the Purchasing Branch provides only the essential elements of management information necessary to fulfill external reporting requirements.

The rate of collection and analysis of current information does not provide management with a truely current picture of work unit performance. Significant management enhancements are possible given only the information currently being collected by the manual information system; however, this would require additional personnel to organize, collate and calculate data into finer levels of granularity than is now possible. The development of an automated information system, utilizing much the same input data as is now collected, would improve management control by providing daily as opposed to monthly information. An automated system, with no increase in manpower (also no decrease), could provide additional information on individual buyer production and backlog, improve visibility of cancellations, improve determination of PALT by purchase type, analyze customer mix and greatly enhance the visibility and follow-up on procurement referrals. By providing this information on a daily basis as opposed to monthly, management would be afforded an opportunity to plan and act in a real-time mode as opposed to reacting to monthly output statistics.

Conclusion #2

An automated MIS for the Purchasing Branch can be implemented utilizing microcomputer technology if desired.

As proposed, the MIS for the Purchasing Branch is completely autonomous, i.e. there is no interfacing with extra-organizational elements. This aspect of the design has made possible a remarkably small system with none of the complications which are generally associated with larger integrated data bases and their resultant proliferation of newer and ever changing output requirements. All data elements in the proposed system are solely 'owned' by the

Purchasing Branch. This fact, together with the small size and few number of output applications obviates the need for a data base management system (DBMS) and its attendant software and hardware expenses. The result is a system which may be implemented on a large microcomputer utilizing traditional application programming techniques.

C. RECOMMENDATIONS

Throughout this study, emphasis has been placed upon developing a system to meet the information needs of management. The prime constraint associated with the project has been cost. Fortunately, the system requirements to meet the needs of management have been determined to be relatively small, and the result has been little or no trade-off required between output quality and system cost. In effect, both goals can be achieved utilizing existing microcomputer technology.

Before making specific recommendations regarding the structure of the proposed system, it should be noted that the existing facilities at the Naval Postgraduate School afford a unique opportunity to system developers. That is, the existence of a large and powerful mainframe computer facility and multiple minicomputer systems on the campus. The feasibility of developing the proposed MIS around one of these systems on a time sharing basis should be examined before attempting to procure any microcomputer components. Such systems offer distinct advantages:

1. Reliability of the larger system is better than that of a microcomputer, and maintenance down-time is drastically improved by on-site technicians. Hardware maintenance costs could be reduced through negotiated maintenance agreements already in existence on the larger equipment.

2. The larger bus structures and word sizes of the mini and maxi computers would improve application run-time significantly.

3. Application programs for updating and report generation could be run during the evening/night by full time system operators and thus make more time available during the day for buyer personnel to enter input. Indeed, on the larger machines multiprogramming could accomodate data entry to storage and production programming simultaneously.

4. The high level languages available on the larger machines are more programmer efficient and would tend to decrease application programming and maintenance costs.

Failure to adequately explore the use of the larger hardware systems would eliminate a unique opportunity--one which could well provide first rate service at less cost than a microcomputer hardware package.

Recommendation #1 - Secure approval to implement the proposed MIS utilizing the IBM System 3033 located at the Naval Postgraduate School's W. R. Church Computer Facility.

Implementation of the proposed MIS utilizing this facility would provide the advantages discussed above, and would decrease the hardware aquisition costs dramatically by requiring only the rental or purchase of a single programmable terminal for key entry and editing of input transactions. This terminal would be located in the offices of the Purchasing Branch for ease of access, and would be hard wired into terminal controllers for the System 370. Storage would be accomplished on existing IBM disk equipment, and output would be generated by the IBM 1403 line

printers. Development of application programming utilizing an ANSI COBOL compiler would afford a high degree of upward compatibility with future systems which may seek to integrate all aspects of the Supply Department and Comptroller Department into a single, large MIS and transaction processing system.

Recommendation #2 - If recommendation #1 is not possible to implement, then procure a microcomputer system with a minimum of 64,000 bytes of main memory, a dual disk drive for secondary storage, a CRT input terminal and a serial output printer.

Microcomputer technology is adequate to support the proposed system and would require very little investment. Disk storage could be accomplished utilizing either floppy or hard disk devices, however, the author recommends the hard disk technology since it typically has better reliability and greater storage capacity for future expansion. In addition the author recommends that a dual (two) disk drive system be procured even though a single disk would suffice. This will allow for coping of disks and file transfer. The CRT terminal for data entry need not be programmable if the input edit function is built into the microcomputer, however, the forms generation capability on a programmable CRT terminal would greatly improve data entry efficiency. The cost trade-off would be the determining factor for this component. Output requirements associated with this system are relatively small, and it was shown that even a small 'daisy wheel' printer could handle the volume. A line printer is not recommended. Any reliable serial printer, compatible with the other components, would be sufficient.

It is important to note that the use of a microcomputer system would probably involve longer periods of down-time in which no output from the system would be possible. Consequently, it is strongly recommended that a parallel manual system, similar to that proposed for raw data collection, be maintained. This data would require manual analysis and expenditure of manpower only when the automated system was disabled.

As with any microcomputer system, application programming and maintenance is weak. Choice of programming languages are limited and typically are not as programmer efficient as those offered on larger computer systems. It is imperative that system developers select a language, such as COBOL, which will offer a high degree of upward compatibility and ease of maintenance in the event that future developments dictate an integration of the proposed system with those in other divisions and departments.

APPENDIX A

TRANSACTION CODE 1---INITIAL INPUT OF REQUISITION

FIELD SIZE/TYPE	DESCRIPTION
1/alpha	Service Code Note: For procurements initiated by the Naval Postgraduate School and other shorebased activities use 'N'
13/numeric	Document Number as submitted on requisition by requisitioner
4/numeric	Julian Date Received
2/numeric	Priority Assigned
2/numeric	Code of Buyer Assigned
1/numeric	Transaction Code must be '1'

APPENDIX B

TRANSACTION CODE 2---ASSIGNMENT OF SOLICITATION NUMBER

FIELD SIZE/TYPE	DESCRIPTION
1/alpha	SERVICE CODE: Note: For procurements initiated by the Naval Postgraduate School and other shorebased activities use 'N'
13/numeric	Document Number as submitted on the initial transaction code '1' which established this record.
14/alpha numeric	Solicitation Number assigned Note: Sixth character must = alpha
2/numeric	Code of assigned buyer
1/numeric	Transaction Code must be '2'

APPENDIX C

TRANSACTION CODE 3---CONTRACT AWARD AND COMPLETION

FIELD SIZE/TYPE	DESCRIPTION
1/alpha	Service Code Note: For procurements initiated by the Naval Postgraduate School and other shorebased activities use 'N'
13/numeric	Document Number as submitted on the transaction code '1' which established this record
14/alpha numeric	Order/Contract Number assigned Note: Sixth character must be C,M,A,F,Y (to distinguish contracts, purchase orders, BPA, imprest and delivery orders)
4/numeric	Julian Date completed
4/numeric	Estimated Delivery Date
2/numeric	Code of Buyer assigned
1/alpha	Contractor Size Note: Large Business Small Business Educ/Nonprofit Minority Business Woman-Owned
1/alpha	Purchase Mehtod Note: Negotiated Formal Advertising
1/alpha	Unpriced Purchase Order

APPENDIX C (Continued)

FIELD SIZE/TYPE	DESCRIPTION
7/numeric	Total Price
1/alpha	Purchase Type Note: Contract Purchase Order Imprest Fund BPA Delivery Order Modification
1/alpha	Competition/Noncompetition Note: Competitive Noncompetitive Under $500 Orders on FSS
1/numeric	Transaction Code must be '3'

APPENDIX D

TRANSACTION CODE 4---SELECTED CHANGES

FIELD SIZE/TYPE	DESCRIPTION
1/alpha	Service Code Note: Must be identical to the TC1
13/numeric	Document Number Note: Must be identical to TC1
14/alpha numeric	Change Order/Contract/Solicitation Number Note: Sixth character must = alpha
2/numeric	Change Priority
2/numeric	Buyer Code
4/numeric	Change Estimated Delivery Date
1/alpha	Change Contractor Size Note: Large Business Small Business Educ/Nonprofit Minority Business Woman-Owned
1/alpha	Change Purchase Method Note: Negotiated Formal Advertising
1/alpha	Modification of Dollar Amount Note: Increase or Decrease
7/numeric	Dollar Amount
1/alpha	Unpriced Purchase Order

APPENDIX D (Continued)

FIELD SIZE/TYPE	DESCRIPTION
1/alpha	Change Purchase Type Note: Contract Purchase Order Imprest Fund BPA Delivery Order Modification
1/alpha	Change Competition Code Note: Competitive Noncompetitive Under $500 Orders on FSS
1/numeric	Transaction Code must be '4'

APPENDIX E

TRANSACTION CODE 5---CANCELLATIONS

FIELD SIZE/TYPE	DESCRIPTION
1/alpha	Service Code Note: Must match TC1 input
13/numeric	Document Number Note: Must match TC1 Input
4/numeric	Julian Date Cancelled
2/numeric	Code of Buyer Assigned
1/alpha	Reason for Cancellation
1/numeric	Transaction Code must be '5'

APPENDIX F

TRANSACTION CODE 6---REFERRAL OF A REQUISITION

FIELD SIZE/TYPE	DESCRIPTION
1/alpha	Service Code Note: Must match TC1
13/numeric	Document Number as submitted on the transaction code '1' which established this record
5/numeric	UIC of Referral Activity
4/numeric	Julian Date Referred
4/numeric	Julian Date Referral Response due
2/numeric	Code of Buyer assigned
1/numeric	Transaction Code must be '6'

APPENDIX G

DATA ELEMENT DICTIONARY

Name of Data Element	Service Code			
Variable Name	SVC CODE			
Definition	A Designation identifying shorebased activities from fleet activities, and Pacific Fleet from Atlantic Fleet activities.			
Classification and Coding	'N' equals shorebased 'R' equals Pacific Fleet 'V' equals Atlantic Fleet			
Uses	Used as first position of all document numbers.			
Derivation Rule	Source is NAVCOMPT Manual			
Units	N/A			
Format	ALPHA	Justification	N/A	
Width of Field	1 character			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional			
Editing	This element must be checked by edit routine upon entry of all types of input.			
Comments	This element will appear on the requisition presented by the customer. It will always be in the first position of the document number.			

APPENDIX G (Continued)

Name of Data Element	Document Number			
Variable Name	DOC NUM			
Definition	This is a unique number assigned to all requisitions. It is composed of the customer's UIC the julian date and serial number (as assigned by the customer). It may not be duplicated.			
Classification and Coding	N/A			
Uses	Used to identify a single requisition from all other requisitions.			
Derivation Rule	Source is customer's requisition.			
Units	N/A			
Format	Numeric	Justification	N/A	
Width of Field	13 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional			
Editing	This element must be edited on every transaction input into system.			
Comments	This element will be provided by the customer. It is a key sort element associated with many output reports.			

APPENDIX G (Continued)

Name of Data Element	Julian Date Received			
Variable Name	DATE RECD			
Definition	Julian date on which the procurement request entered the purchasing branch.			
Classification and Coding	N/A			
Uses	To establish beginning of PALT cycle and aging of backlog.			
Derivation Rule	This date will be entered by the control clerk upon submission of the TC1 transaction code into the system.			
Units	N/A			
Format	Numeric	Justification	N/A	
Width of Field	4 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXX	TBD		
	Optional			
Editing	This element must be edited on all TC1 transactions			
Comments				

APPENDIX G (Continued)

Name of Data Element	Priority Assigned			
Variable Name	PRI			
Definition	Degree of urgency assigned to each requisition.			
Classification and Coding	01 through 15			
Uses	To establish order of precedence for processing of requisitions.			
Derivation Rule	Submitted on requisition by customer.			
Units	N/A			
Format	Numeric	Justification		
Width of Field	2 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXX	TBD		
	Optional			
	XXXXXXX	TBD		
Editing	Must be edited on all TC1 transactions Optional on TC4.			
Comments				

APPENDIX G (Continued)

Name of Data Element	Buyer Code			
Variable Name	BC			
Definition	Identification of a specific buyer assigned to process a given requisition			
Classification and Coding	01 through 99			
Uses	To document responsibility for the progress of each requisition through the system.			
Derivation Rule	Assigned by supervisor or control clerk			
Units				
Format	Numeric	Justification		
Width of Field	2 digits			
Validity Rules	Required: XXXXXXXX	Range	Content	Other
	Optional			
Editing	Must be edited on all input transaction			
Comments	This is a key sort element for output report purposes.			

APPENDIX G (Continued)

Name of Data Element	Transaction Code			
Variable Name	TC			
Definition	Identification of the type of input being submitted for update.			
Classification and Coding	1 through 6			
Uses	To establish input criteria by transaction type. See App. A through F			
Derivation Rule	Buyer assigns during input process.			
Units				
Format	Numeric	Justification		
Width of Field	1 digit			
Validity Rules	Required	Range	Content	Other
	XXXXXXX	TBD		
	Optional			
Editing	Must be present on every input transaction.			
Comments				

APPENDIX G (Continued)

Name of Data Element	Solicitation Number			
Variable Name	SLCT NUM			
Definition	This number is assigned to every requisition requiring bids by vendors. It is not the same as a contract number. It is a unique number associated with a single requisition.			
Classification and Coding	See below.			
Uses	Establishes the status of a given procurement as pending vendor response.			
Derivation Rule	Provided by buyer.			
Units	N/A			
Format	Alpha/Numeric	Justification	N/A	
Width of Field	14 (13 digits/alpha) sixth post. alpha			
Validity Rules	Required	Range	Content	Other
	XXXXXXX	TBD		
	Optional			
	XXXXXXXX	TBD		
Editing	Must be edited prior to input on all TC2 input. Optional on TC4 input.			
Comments				

APPENDIX G (Continued)

Name of Data Element	Contract/Order Number			
Variable Name	CONT NUM			
Definition	Unique number associated with a specific procurement and establishing the award of the procurement to a specific vendor.			
Classification and Coding	See below.			
Uses	Establishes status of each procurement request, i.e., a specific vendor has been awarded the opportunity to provide the requested matl. Completes the final phase in the system lifecycle.			
Derivation Rule	Provided by buyer.			
Units				
Format	Alpha/Numeric	Justification		
Width of Field	14 (13 numeric/1alpha) sixth position must be C,M,A,F, or Y			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional			
Editing	Appears on every transaction and must be edited for accuracy.			
Comments	This is key sort element for report purposes.			

APPENDIX G (Continued)

Name of Data Element	Julian Date Completed			
Variable Name	DATE COMP			
Definition	The actual date on which the TC3 transaction is entered into the system.			
Classification and Coding	N/A			
Uses	To provide an end point for the calculation of PALT.			
Derivation Rule	Provided automatically by system upon entry of TC3.			
Units				
Format	Numeric	Justification		
Width of Field	4 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional XXXXXX	TBD		
Editing				
Comments	Key element for determining PALT calculations.			

APPENDIX G (Continued)

Name of Data Element	Estimated Delivery Date			
Variable Name	ESD			
Definition	The vendors estimation of when material will be provided.			
Classification and Coding	N/A			
Uses	To provide query response to customers.			
Derivation Rule	Provided by vendor and entered by buyer on TC3			
Units				
Format	Numeric	Justification		
Width of Field	4 digits			
Validity Rules	Required	Range	Content	Other
	Optional XXXXXXX	TBD		
Editing				
Comments	This is not a critical sort element for report purposes.			

APPENDIX G (Continued)

Name of Data Element	Contractor Size			
Variable Name	VEND SIZE			
Definition	This element stratifies the vendor by numbers of employees, dollar sales.			
Classification and Coding	Large, Small, Nonprofit, Minority, Women-owned			
Uses	To provide information on equitable award of government contracts. For external reporting purposes.			
Derivation Rule	Provided by buyer.			
Units				
Format	Alpha	Justification		
Width of Field	1 digit			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional			
	XXXXXXXX	TBD		
Editing	Must be edited prior to input of all TC3. Optional on TC4.			
Comments	Key element for report purposes.			

APPENDIX G (Continued)

Name of Data Element	Unpriced Purchase Order			
Variable Name	UNPR			
Definition	Some purchase orders may not be fixed in price.			
Classification and Coding	'U' Unpriced 'P' Priced			
Uses	To respond to external reporting needs.			
Derivation Rule	Provided by buyer.			
Units				
Format	Alpha	Justification		
Width of Field	1 character			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional XXXXXXXX	TBD		
Editing	Must be edited on all TC3. Optional on all TC4.			
Comments				

APPENDIX G (Continued)

Name of Data Element	Total Price			
Variable Name	DOL VAL			
Definition	The sum total dollar amount chargeable against a given requisition.			
Classification and Coding	N/A			
Uses	To repond to internal and external reporting needs.			
Derivation Rule	Provided by vendor and inputed by buyer.			
Units	Dollars			
Format	Numeric	Justification		
Width of Field	7 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional			
	XXXXXXXX			
Editing	Required editing on all TC3 input. Optional on TC4.			
Comments	Key element for report purposes.			

APPENDIX G (Continued)

Name of Data Element	Purchase Type			
Variable Name	PR TYPE			
Definition	Stratification of each procurement by type of procurement.			
Classification and Coding	Purchase Order, Contract, Imprest Fund, BPA, Delivery Order, Modification			
Uses	To provide internal management information, and reporting needs.			
Derivation Rule	Provided by Buyer			
Units				
Format	Alpha	Justification		
Width of Field	1 character			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional XXXXXXXX	TBD		
Editing	Must be on all TC3. Optional on all TC4.			
Comments	Key element for report purposes.			

APPENDIX G (Continued)

Name of Data Element	Purchase Method			
Variable Name	PR MTHD			
Definition	To stratify each procurement by informal bid procedure or by formal bidding/advertising.			
Classification and Coding	Negotiated, Formal Advertising			
Uses	For internal and external reporting purposes.			
Derivation Rule	Provided by buyer.			
Units				
Format	Alpha	Justification		
Width of Field	1 character			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional XXXXXXXX	TBD		
Editing	Must be edited on all TC3.			
Comments	Key element for report purposes.			

APPENDIX G (Continued)

Name of Data Element	Competition/Non-competition			
Variable Name	COMP			
Definition	The existence of multiple vendors each proviiing bids in anticipation of winning the award.			
Classification and Coding	Competition, Non-competition, Under $500.00, orders on FSS.			
Uses	For internal and external reporting purposes.			
Derivation Rule	Provided by buyer.			
Units				
Format	Alpha	Justification		
Width of Field	1 character			
Validity Rules	Required	Range	Content	Other
	XXXXXXX	TBD		
	Optional XXXXXXX	TBD		
Editing	Must appear on all TC3. Optional on TC4.			
Comments	Key element for report purposes.			

APPENDIX G (Continued)

Name of Data Element	Modification of Dollar Amount			
Variable Name	MOD			
Definition	This is an indicator of a change in the dollar amount previously entered on a contract/order. It indicates an increase or decrease, but not the amount of the change.			
Classification and Coding	'I' equals increase 'D' equals decrease			
Uses	Used to denote changes in previously reported contracts/orders.			
Derivation Rule	Provided by buyer making the change.			
Units	N/A			
Format	Alpha	Justification		
Width of Field	1 character			
Validity Rules	Required	Range	Content	Other
	Optional XXXXXXXX	TBD		
Editing	This is an optional entry on all input transactions, however, for changes in the dollar amount of existing contracts/orders utilizing a TC4 it is a required entry in order to change the dollar amount previously posted.			
Comments				

APPENDIX G (Continued)

Name of Data Element	Julian Date Cancelled			
Variable Name	DATE CANC			
Definition	This is the date that a procrement action is cancelled. The material is either not available, is not authorized for procurement, or the requisitioner no longer requires it.			
Classification and Coding	N/A			
Uses	Used to denote requisitions which can not be completed or, at the discretion of the requisitioner, are no longer needed. This transaction will have effect of terminating the record.			
Derivation Rule	Provided by buyer assinged to the procurement after discussion with the requisitioner.			
Units	N/A			
Format	Numeric	Justification		
Width of Field	4 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional			
Editing	This is a required entry on the TC5 transaction. It must be edited.			
Comments				

APPENDIX G (Continued)

Name of Data Element	Reason for Cancellation			
Variable Name	REASON CANC			
Definition	This provides managers with an explanation why the procurement action was not carried out as previously requested.			
Classification and Coding	This element would be delineated by a single character and a table look-up.			
Uses	This is a prime element documenting the reason for an unsuccessful fulfillment of a procurement action. Managers are keenly aware of such transactions.			
Derivation Rule	Provided by buyer.			
Units	N/A			
Format	Alpha	Justification		
Width of Field	1 character			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX			
	Optional			
Editing	This is a required element on all TC5 transactions. It must be edited.			
Comments				

APPENDIX G (Continued)

Name of Data Element	UIC of Referral Activity			
Variable Name	REF UIC			
Definition	This is the unit identification code of a specific activity having cognizance over a particular procurement.			
Classification and Coding	N/A			
Uses	This element tells the buyer and management alike, where a particular procurement action has been forwarded for action. It is used for follow-up and expediting.			
Derivation Rule	Supplied by the buyer at the time of referral.			
Units	N/A			
Format	Numeric	Justification		
Width of Field	5 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXXX	TBD		
	Optional			
Editing	This is a required element on all TC6. It must be edited.			
Comments				

APPENDIX G (Continued)

Name of Data Element	Julian Date Referred			
Variable Name	REF DATE			
Definition	This is the day that the buyer takes action to pass the procurement to an outside command for action.			
Classification and Coding	N/A			
Uses	This element will serve as a tickler for timely follow-up action on the part of buyers assigned to a given procurement.			
Derivation Rule	Provided by the buyer when referred.			
Units	N/A			
Format	Numeric	Justification		
Width of Field	4 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXXXX	TBD		
	Optional			
Editing	This entry is required on all TC6. It must be edited.			
Comments	Some linkage with the PALT determination formula is indicated in order to suspend the PALT calculation while in the hands of the the referral activity.			

APPENDIX G (Continued)

Name of Data Element	Date Referral Response Due			
Variable Name	RESP DUE			
Definition	This date is supplied by the buyer at the time a TC6 is entered to serve as a reminder to query the referral activity if no response has been received.			
Classification and Coding	N/A			
Uses	Serves as a tickler system for overdue referral actions.			
Derivation Rule	This date is provided by the buyer upon information previously provided by the referral activity.			
Units	N/A			
Format	Numeric	Justification		
Width of Field	4 digits			
Validity Rules	Required	Range	Content	Other
	XXXXXXX	TBD		
	Optional			
Editing	Editing of this transaction is required on all TC6 input.			
Comments				

LIST OF REFERENCES

1. Gessford, John Evans, Modern Information Systems, Addison-Wesley Publishing Company. 1980

2. Hussain, D., and Hussain, K. M., Information Processing systems for Management, Richard D. Irwin Publishing Company, 1981

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